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ABSTRACT

This study uses a habituation paradigm to systematically investigate the discrepancy hypothesis with male and female new borns. In addition, multiple visual response measures are used in monitoring the habituation process and the infant's response to various degrees of novelty. Ss were 36 apparently normal newborns (half of each sex) ranging in age from 28 to 82 hours. A target was placed against the inside of the infant's crib, and two observers stood behind it, facing the infant. Total looking time and number of looks were recorded. Non-glossy, black and white checkerboard targets in three sizes were used as visual stimuli. Each trial consisted of a 60-second exposure, and presentations continued until evidence of response decrement in looking time occurred. Each infant received one 60-second trial 5-10 seconds after the last decrement criterion trial. The hypothesis that infants are capable of demonstrating habituation to visual stimuli was supported. The findings also demonstrate that the visual response of female newborns is compatible with the discrepancy hypothesis. The response of females in this study is consistent with reports of sex differences indicating that the female newborn is generally more responsive and receptive to sensory stimulation than is the male. It is clear that effects attributable to sex cannot be explained effectively without reference to the context of stimulation. [Filmed from best available copy.] (KM)

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Differential Dishabituation as a Function of Magnitude of Stimulus Discrepancy and Sex of the Newborn Infant[1]

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Attentional processes have been studied in young infants using a variety of response measures (e.g., heart-rate, sucking suppression, motor quieting, looking time). All of these indices provide support for the young human infant as a perceptually competent organism. Recent studies by Sameroff and colleagues (1973) using a heart-rate measure and by Friedman and colleagues (1972) using a looking time measure, support the notion that the infant, in the first few days of life, is capable of processing visual input from the immediate external environment.

Related to the fairly well developed processing capabilities of the young infant is the "discrepancy hypothesis" which states that stimuli which represent a moderate degree of discrepancy from an existing schema will recruit maximal attention whereas those that are either very similar to the previously formed schema or widely discrepant from it will recruit lesser amounts of attention. Attention is therefore seen as a curvilinear function of the magnitude of the discrepancy from some "familiarized" standard stimulus. McCall (1972) recently reported evidence for this hypothesis using looking time as the dependent measure with 4 and 5 1/2 month old infants and also observed a sex difference with females displaying a discrepancy effect at an earlier age than males. No data testing this hypothesis has been reported with infants younger than 12 weeks of age.

A great deal of recent data have accumulated on sex differences in early infant behavior (Korner, 1973; Olley, 1971). Korner in a review on sex differences in neonates, concludes that females seem to be more sensitive and receptive to sensory stimulation than are males.

The current study uses a habituation paradigm to systematically investigate the discrepancy hypothesis with male and female newborn infants. In addition, multiple visual response measures are used in monitoring the habituation process and the infant's response to various degrees of novelty. The report also serves as an attempt to replicate, across hospitals, the habituation phenomenon previously observed with human newborns.

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Method

Subjects

The subjects were randomly selected from a population of apparently normal human newborn infants from the Nashville, General Hospital nursery who were awake and alert at the time of observation (which was between 7 and 8:30 a.m., prior to the morning feed). In order to obtain 36 Ss for the experimental design 83 Ss were initially observed. Exclusions were made for reasons of failure to reach the habituation criterion (i.e., no habituation) or vigorous fussing or drowsiness during the experimental session. The 36 Ss, who were divided equally by sex, ranged in age from 28 to 82 hours.

Procedure

The experimental session was conducted in the nursery at the infant's crib where the newborn was placed on his right side. A target was manually inserted against the inside of the infant's crib at approximately 19 cm. Two observers were positioned at the side of the crib behind the target, facing the infant. A Rustrak 4-channel event recorder with 2 silent remote buttons (each representing one channel on the recorder) was used in providing measures of total looking time and number of looks Looking time was defined as the time during which the infant orients his eyes towards the target. Interobserver reliability yielded Pearson correlations of +0.96 and +0.88 for the look time and number of looks measures, respectively. A Gra-Lab timer was connected to one of the push-button switches and was activated when one observer depressed his button. This provided that observer with the cumulative looking time of the infant on each trial so that he could expeditiously calculate when the infant had met the decrement criterion.

Three visual stimuli were employed and consisted of 4-SQ, 16-SQ, and 144-SQ non-glossy black and white checkerboard targets (15.2 x 15.2 cm). Each trial consisted of a 60-second exposure of either the 4-SQ or 144-SQ target separated by a 5-10 second ITI during which time the target was removed. A clock timer was used to indicate the completion of each 60-second presentation. Presentations continued until evidence of response decrement in looking time occured as determined by the following previously employed criterion: two consecutive trials eight seconds or less than the mean of trials one and two. When the infant reached the decrement criterion a random determination was made as to whether to present the "same" target to which S had shown decrement (control or no-change group) or present a target of either moderate or large discrepancy from the standard habituation stimulus. Each infant received one 60-second trial, 5-10 seconds after the last decrement criterion trial. The test trial consisted of introduction of either the 4, 16 or 144 SQ target following habituation to either the 4 or 144-SQ pattern.

Design

The independent variables were Degree of Discrepancy, Decrement Target and Sex. There were three levels of discrepancy, two decrement targets and two sexes (i.e., a 3 x 2 x 2 design). The dependent variables were total looking time and number of looks.

Results

Looking Time Results: Regarding degree of response decrement to repetition of the checkerboard patterns, no differences were found between decrement targets (4 and 144 square), between sexes, or between discrepancy groups.

In order to test for the presence or absence of recovery of response, the mean looking time of the last three decrement trials for each subject was compared with his performance on the test trial. Using a repeated measures ANOVA, the results revealed a significant Discrepancy Group X Sex X Trials interaction ($p < .05$).

Slide 1

In order to interpret this triple interaction a Sex X Trials ANOVA was performed separately for each discrepancy group. Slide 1 graphically displays the results of these analyses. The vertical axis is labeled mean looking time and the horizontal axis represents the performance of each discrepancy group on the mean of the last 3 trials and the test trial. As Slide 1 indicates the control group (i.e., Ss receiving the same target on the test trial to which they had been 'familiarized') showed no significant change on the test trial. The larger change or high discrepancy group showed a significant increase in looking time (the interaction of Sex X Trials was not significant.) Results from the moderate discrepancy or smaller change group revealed a significant Sex X Trials interaction ($p < .025$) indicating that a reliable recovery effect was demonstrated by the females but not be the males. In fact, all six females in the moderate discrepancy group showed a 5-second or more increase in looking time on the test trial while only one male showed a comparable increase (Fisher Exact Test; $p < .01$).

The next slide reformulates the data in terms of the discrepancy hypothesis

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Slide 2

As can be seen in this slide, females are showing maximal response to the smaller change, while males are responding to the smaller change as if no change was introduced.

Number of Looks Results

The number of looks measure also reflected the infants' response to presentation of familiar and novel visual stimuli (see Slide 3). Initial exposure to the visual stimulus resulted in few looks per trial. Upon reaching

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Slide 3

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the decrement criterion (i.e., on the last 3 decrement trials) the mean number of looks increased to about 5 1/2--6 per trial, decreasing significantly with introduction of the new target. As can be observed, the control group showed a further increase in number of looks on the test trial (mean=7.4). An ANOVA comparing mean number of looks on the last three decrement trials with the test trial indicated that the experimental groups showed a reliable decrement in number of looks as compared with the control group. The triple interaction of Discrepancy Group X Sex X Trials was of borderline significance ($p=.071$) in this analysis. The next slide (Slide 4) indicates that while females are

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Slide 4

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showing a dramatic reduction in number of looks with introduction of the smaller change, males are showing no differential responding. Notice also that in the larger change group both males and females are detecting the novel stimulus as reflected in a decrease in number of looks.

Individual Infant Data

Slide 5 presents data on some exemplary babies. The two lines on each figure represent the independent judgments of two observers.

Slide 5

The upper left figure displays the response of a 72 hour old male in the larger change condition who was exposed to the 4-square pattern during habituation and to the 144-square on the test trial.

The lower left figure represents the response of a 49-hour old female in the smaller change condition repeatedly exposed to the 144-square pattern until reaching criterion and then presented with the 16-square target. Notice the dramatic increase in looking time and related drop in number of looks on the test trial.

The upper right figure represents the responses of a 46 hour old male in the larger change condition. Again, notice the dramatic increase in looking time with introduction of the novel pattern and concomittant decrease in number of looks.

Finally, the lower right figure represents the data of an 82 hour old male in the larger change condition receiving repeated exposure of the 144-square target and presentation of the 4-square target on the test trial. This infant although showing recovery in looking time on the test trial does not show a dramatic decrease in number of looks as seen in some other infants.

Replication Data

Slide 6

Slide 6 compares the results of a previous study (Friedman, 1972) with the performance of the no change and larger change conditions in the current study. Each [redacted] represents the performance of either control infants (i.e., infants who received the same target on the test trial to which they had been familiarized) or experimental infants (i.e., infants who received a change of target on the test trial either from 4 to 144 or 144 to 4). The two control groups (4-4; 144-144) are combined and the two experimental groups (4-144; 144-4) are combined since within group differences were non-significant. In addition, the control infants also received the novel target one trial following the test trial. A cross hospital ANOVA of this data revealed that neither the hospital main effect nor any of its interactions were significant, indicating a similarity of responses for infants in the two settings. In addition, mean number of trials required in reaching the habituation criterion was 11.8 in the current study as compared with 13.2 in the previous study, a non-significant difference.

Discussion

To summarize the results: first, the original finding that newborn human infants are capable of demonstrating habituation to visual stimuli (Friedman, 1972) has been replicated, providing further confirmation that the young infant is both an active processor of visual input and an organism capable of actively regulating the intake of visual information. The ability of the newborn infant to shut out redundant input by turning his head and/or eyes away from the target and his ability to detect and differentially respond to novelty in his immediate environment may be a precursor of later information regulation capabilities as seen in perceptual studies with older infants (e.g., Carpenter, Tecce, Stechler, and Freidman, 1970); secondly, the findings of the current study demonstrate that the visual response of female newborns is compatible with the discrepancy hypothesis which states that a moderate degree of stimulus change from some level of 'familiarization' will be 'preferred.' This result may reflect a number of possible mechanisms: one possibility is that males may show the inverted U function in the newborn period but we need to go further along the stimulus complexity dimension. Another possibility is that males also show this inverted U function but a bit later in development. As McCall (1972) has pointed out: 'Many of the sex differences observed. . . may be reflections of differences in developmental rate. . . rather than in indication of enduring or pervasive. . . differences between the sexes.' (p. 6) However, the response of the females in this study is consistent with reports of sex differences indicating that the female newborn is generally more responsive and receptive to sensory stimulation than is the male (see Korner, 1973). What is clear, from this and other studies (e.g., Friedman, Nagy, & Carpenter, 1970; Weizman, Cohen & Pratt, 1971) is that effects attributable to sex cannot be explained effectively without reference to the context of stimulation impinging upon the infant. In addition, the use of both sexes seems to be a necessary condition in infant perceptual research if the results are to be generalizable to infant behavior.

Further research in this area may provide some new and exciting measures which have predictive value in developmental assessment as well as providing useful information on basic perceptual processes in early infancy. However, before habituation and other attentional measures can be efficiently used as predictors of later cognitive development what seems to be needed is information on the stability of performance (i.e., test re-test reliability) of individual infants in rate of habituation and response to novelty.

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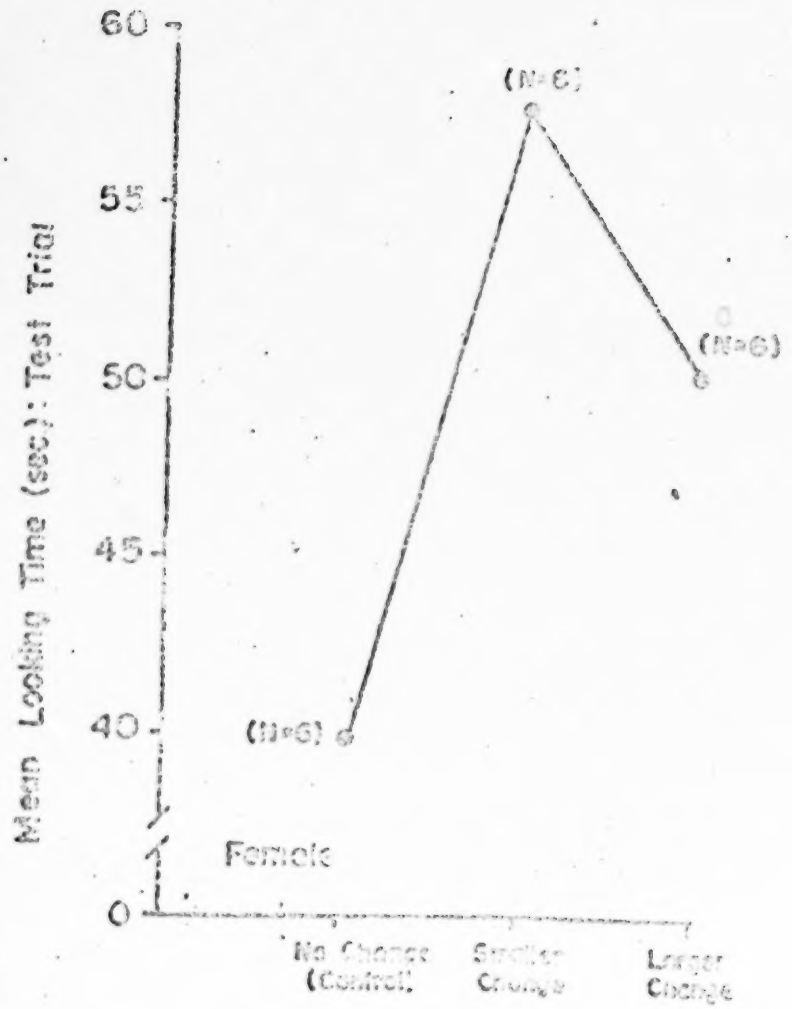
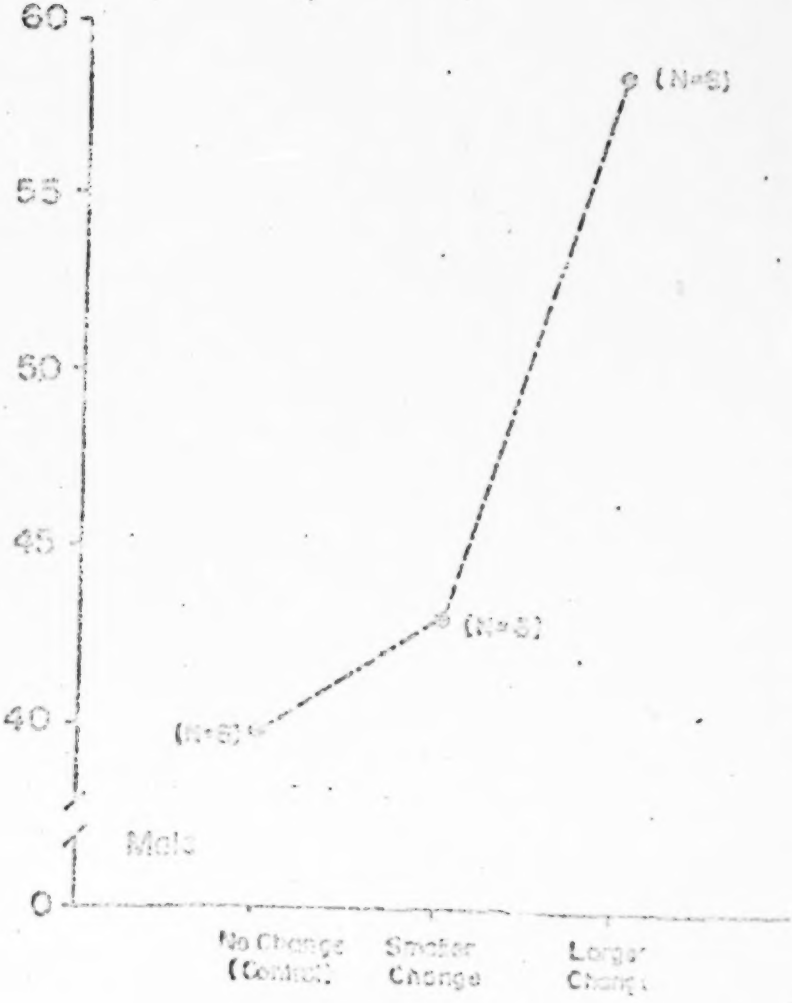
Slide 2





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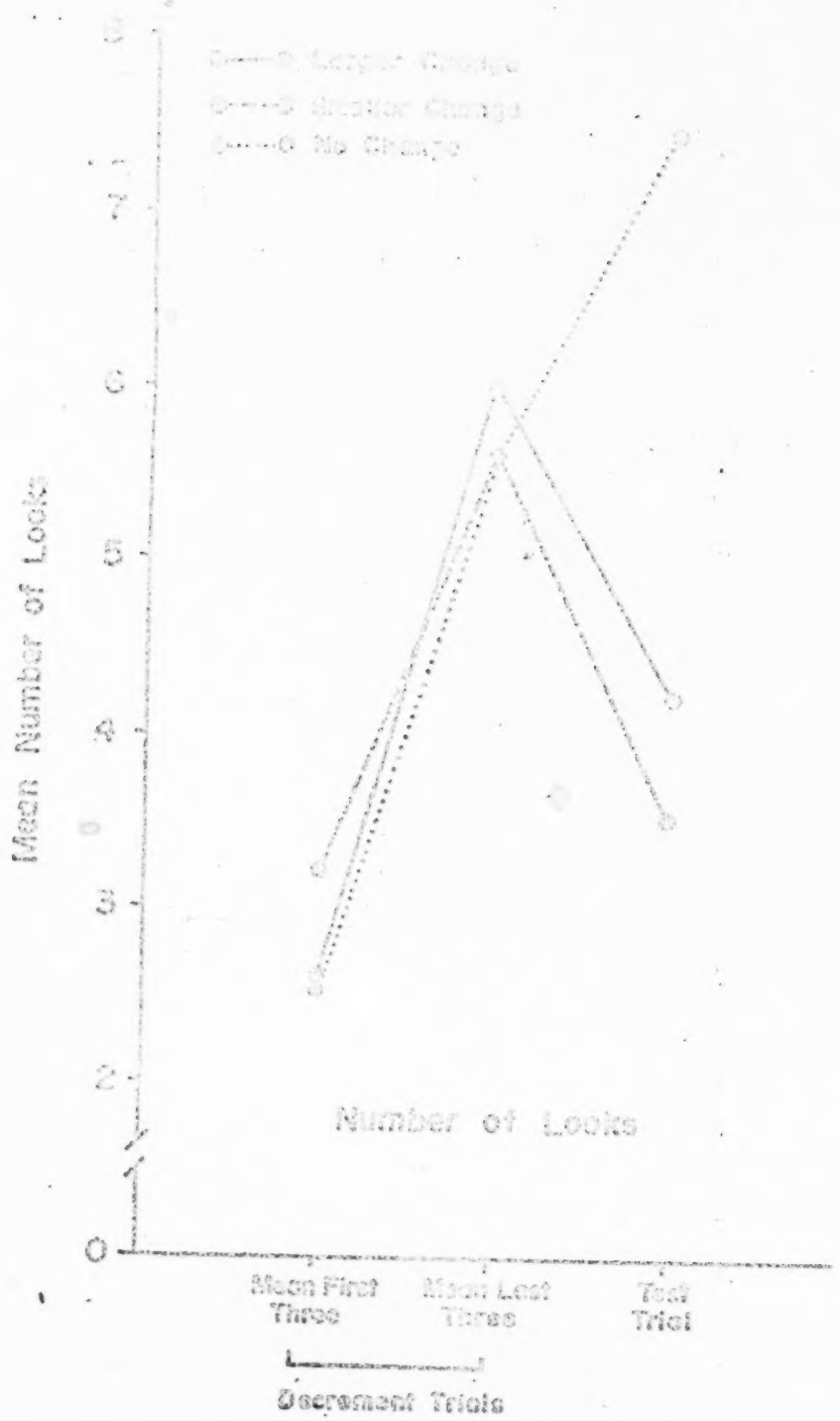
Slide 3



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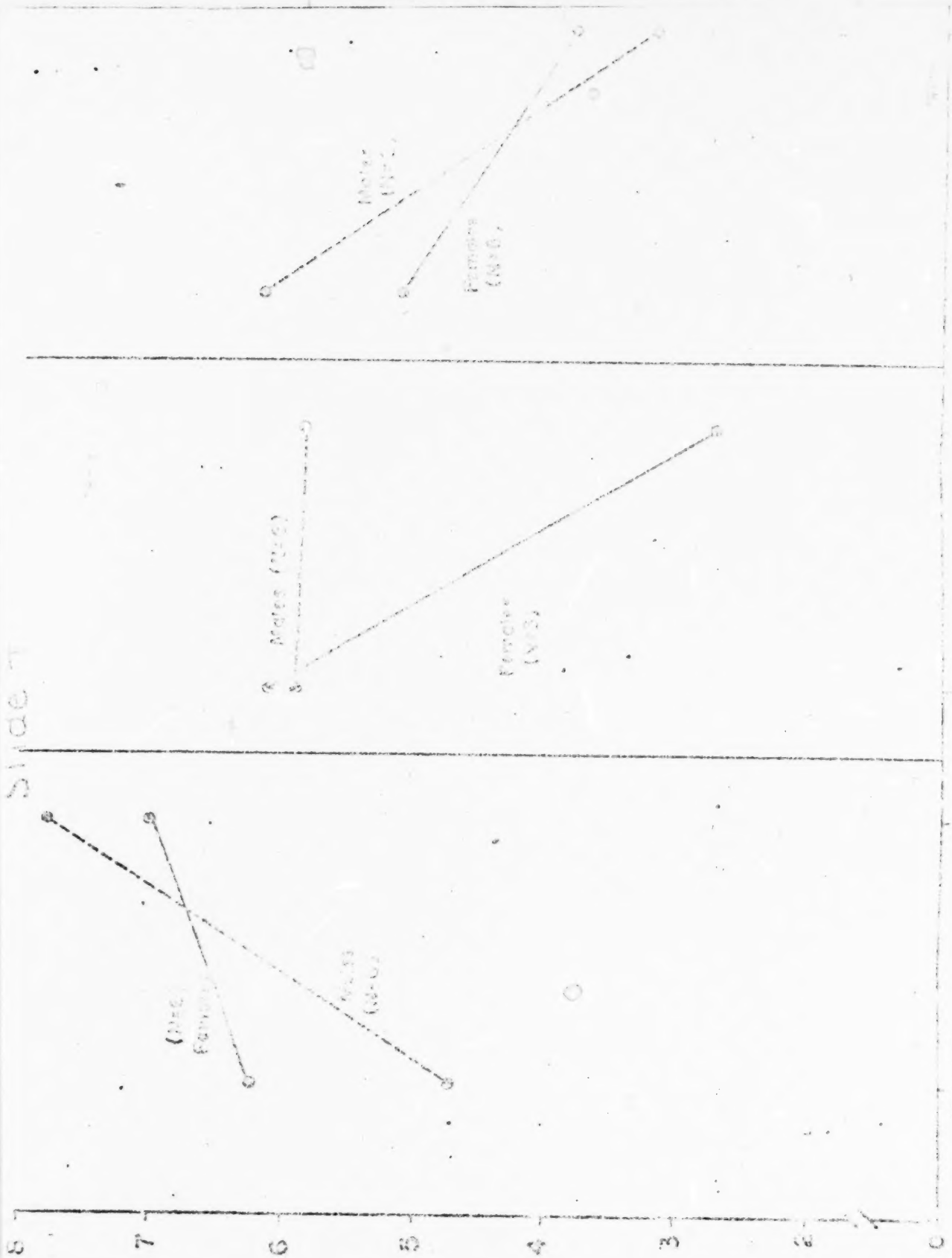

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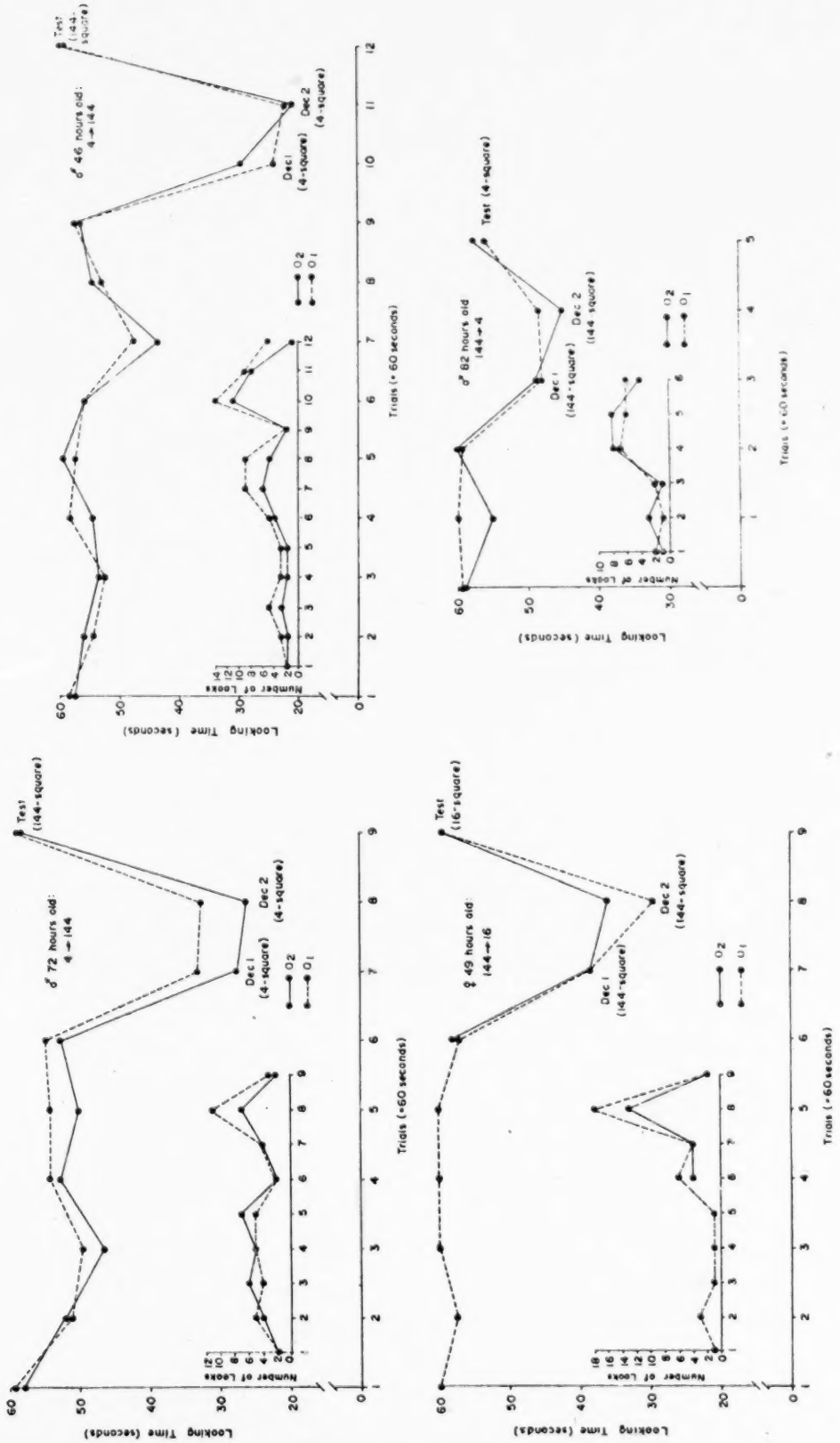
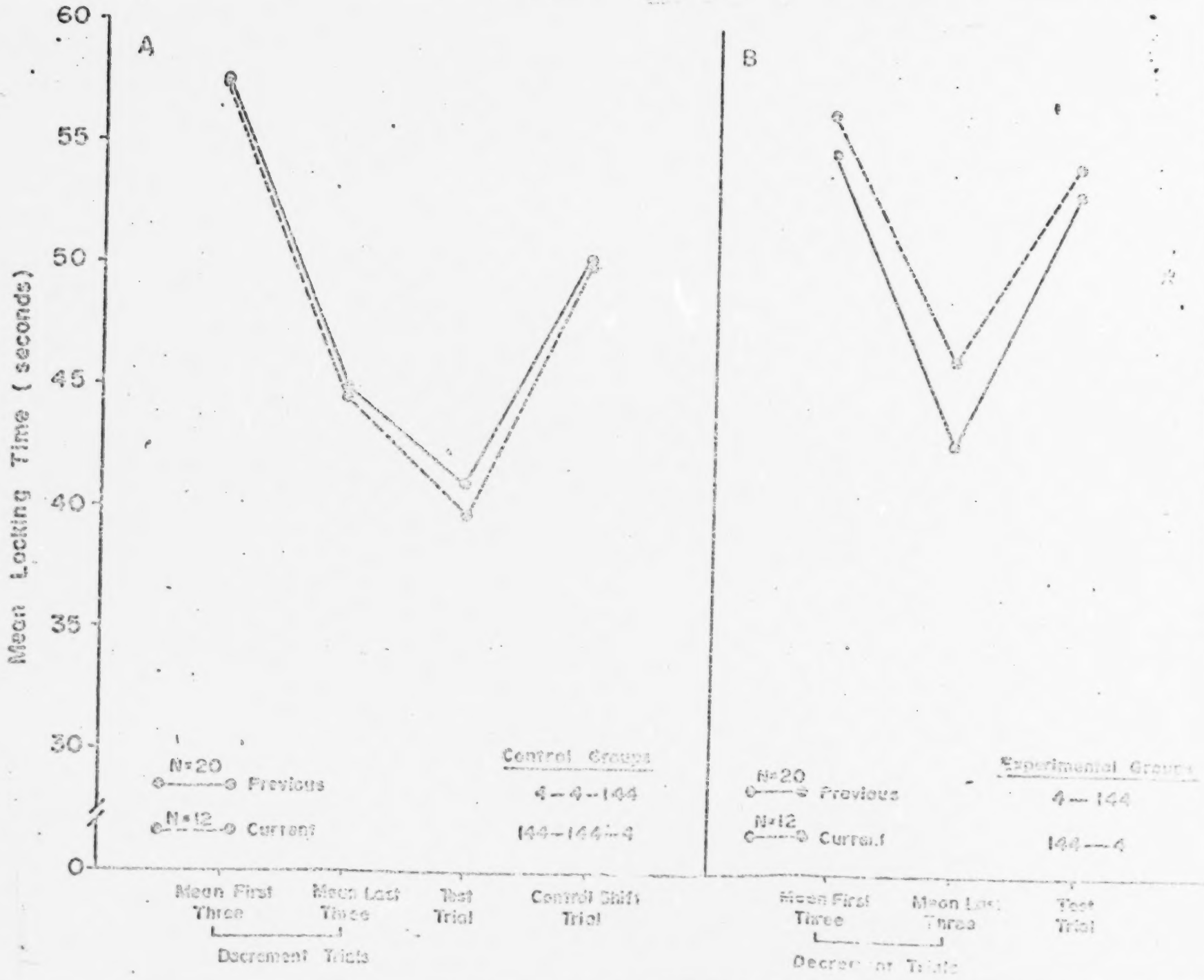
SLIDE 5





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